Memorandum

To: Chris Hempleman
Cc: Dustin Bilhimer, Greg Pelletier, Kirk Sinclair, Lawrence Sullivan, Trevor Swanson, Karol Erickson
From: Mindy Roberts
Date: April 15, 2004
Subject: Deschutes River, Capitol Lake, Budd Inlet TMDL
Quarterly Progress Report #4 (January through March 2004)

Introduction

The Deschutes River, Capitol Lake, Budd Inlet, and tributaries were placed on the 1996 and/or 1998 Clean Water Act Section 303(d) list of impaired waters based on historical monitoring by several organizations. In total, 24 waterbodies have water quality parameter levels that do not meet standards for at least one of the following: temperature, fecal coliform bacteria, dissolved oxygen, pH, nutrients, or fine sediment. The TMDL study began in March 2003 to assess the current condition of the waterbodies and to identify and quantify factors contributing to the impairments. The previous quarterly progress reports (July 31, 2003; December 1, 2003; February 9, 2004) summarized the results of the 2003 monitoring program.

This memorandum summarizes the progress to date related to data collection and project communications. Data presented are provisional; data quality has not been checked.

Progress to Date

Temperature and Hydrogeology Data Collection

Several surface water probes remained installed over the winter and were downloaded in March. Vertical hydraulic gradients in the piezometers were measured. Results indicate that the magnitude and direction of groundwater/surface water exchange varied over the winter. In an example gaining reach shown in Figure 1, surface water temperatures were more variable and generally higher than hyporheic temperatures through the end of October. With the onset of winter, river temperatures dropped markedly while groundwater temperatures remained relatively stable. The vertical hydraulic gradient between the river and groundwater tended to increase with rising river flows suggesting that groundwater discharge to the river increases during the winter at this location. In an example losing reach shown in Figure 2, surface water and hyporheic temperatures tracked each other closely throughout the summer and winter.

Images from the airborne thermal infrared (TIR) remote sensing survey on the Deschutes River that was conducted on August 19, 2003, by Watershed Sciences, LLC are now available on the Ecology website: http://www.ecy.wa.gov/apps/watersheds/temperature/index.html. Both visible riparian images and infrared images are available. These can be viewed as a “fly-over.”

We began to process the Light Detection And Ranging (LiDAR) imagery available through the Puget Sound Lidar Consortium for the Deschutes watershed. Tiled quads were unzipped and imported to ArcView, then mosaiced together into images of the top of canopy and bare earth for the upper and lower watersheds. The six-foot pixels in the native format were smoothed to create 18-foot pixels using either the neighborhood maximum for the top of canopy or neighborhood average for the bare earth data layer. The grids were re-projected to Ecology’s coordinate system standards. Vegetation heights were calculated as the difference between the

top of canopy and the bare earth. While vegetation heights appear reasonable, the results have not been field verified.

Conventional Water Quality Parameter Data Collection and Planning

The reconnaissance monitoring concluded in December 2003, and data were provided in the previous project report. Table 1 presents the geometric mean and percent of samples with fecal coliform concentrations >200/100 mL. Three stations in the Indian/Moxlie watershed had geometric mean concentrations greater than 100/100 mL, while eight stations in the study area had >10% of samples greater than 200/100 mL. Another seven sites had one of ten samples greater than 200/100 mL.

The program also included nutrient and *in situ* data. Figures 3 through 5 present box and whisker plots of the median, 25th and 75th percentile, and the minimum and maximum levels along the Deschutes River and in Percival Creek for nitrogen, phosphorus, and carbon, respectively. Nitrate levels were elevated near Rainier and remained near 0.8 mg/L through the E Street Bridge. Capitol Lake nitrate levels reflect the productivity of the lake, marked by an increase in organic nitrogen. Total nitrogen levels are lower in Capitol Lake than at the E Street Bridge, possibly indicating net accumulation within the lake via settling of organic matter. Orthophosphate levels also declined in Capitol Lake as compared with E Street Bridge levels and organic phosphorus levels increased. Total phosphorus remained constant. Total carbon, almost entirely dissolved, increased slightly in Capitol Lake as compared with E Street bridge levels.

Figures 6 through 11 present summaries of historical Thurston County data for the mainstem Deschutes River and tributaries. As shown in Figure 6, median pH and DO levels gradually decrease through Henderson Blvd. then increase through Capitol Lake. Minimum pH values have been less than 6.5. Figure 7 illustrates that nitrate levels are low at 1000 Rd but increase downstream through Henderson Blvd. Mainstem nitrate levels appear lower (0.6 mg/L) than the 2003 monitoring indicated, possibly because the 2003 data only include the summer and fall period of vegetation senescence generally associated with higher nitrate levels. Total phosphorus and orthophosphate levels increase downstream and show median values similar to but lower than the 2003 monitoring levels in Figure 8.

Tributary pH levels were circumneutral, although some values were less than 6.5 SU, as shown in Figure 9. Historically, nitrate levels were very high in Mission Creek, with elevated levels in Moxlie, Percival, Spurgeon and Reichel creeks (Figure 10). Figure 11 shows that total phosphorus levels were elevated in Mission, Moxlie, and Reichel creeks, while Moxlie had consistently high levels of orthophosphate.

Routine monitoring as outlined in the QAPP began in January and builds on the information collected during the reconnaissance monitoring phase. Samples were collected from the Deschutes River, Capitol Lake, their tributaries, and tributaries to Budd Inlet twice monthly in and analyzed for fecal coliform bacteria. Levels in Moxlie Creek remained elevated during January and March. In addition, Reichel Creek had elevated levels in March. No stations had high levels in February. Table 2 presents fecal coliform data collected to date in 2004.

Nutrient samples were collected twice monthly in January and February and monthly in March. Table 3 presents nutrient and related laboratory data. Total persulfate nitrogen and nitrate values indicated a longitudinal variation in mainstem Deschutes River, with a steady increase downstream to 0.7 to 0.8 mg/L and 0.5 to 0.7 mg/L, respectively. Concentrations were similar within Capitol Lake and at the E Street bridge in January, but levels were lower in the lake than

at the bridge in February and March. The highest nitrogen levels were found in Chambers Creek, with high levels in Ayer and Reichel creeks as well. Percival Creek nitrogen levels were lower than in the Deschutes system. Total phosphorus, orthophosphate, total organic carbon, and dissolved organic carbon levels showed similar patterns. The highest levels were found in Ayer and Reichel creeks, and the Deschutes River had increasing concentrations downstream. Capitol Lake phosphorus and carbon levels were similar to those at the E Street bridge through March.

Dissolved oxygen levels remained below 8 mg/L at Ayer Creek, as shown in Table 4. DO levels at all other locations were between 10 and 13 mg/L. All pH values, shown in Table 5, met water quality standards and ranged from 6.7 to 7.9 SU.

The project team developed the detailed wet weather monitoring plan for tributaries to the Deschutes River, Capitol Lake and Budd Inlet and distributed to City of Olympia and Thurston County for comment. The plan provides additional monitoring station and sample collection information than included in the QAPP. Ecology staff visited the sites in March 2004.

Communication and Coordination

- Completed Quality Assurance Project Plan and made available on the Ecology website: http://www.ecy.wa.gov/biblio/0403103.html.
- Verified that no laboratory services contract is required for Thurston County's Environmental Health laboratory to analyze fecal coliform samples under the grant from Ecology.
- Completed and distributed quarterly report #3 February 9, 2004.
- The project team bid farewell to Brian Zalewsky, who returned home to family in New England. Mindy Roberts will continue to develop the temperature model based on Brian's progress to date.
- Met with Rich Eltrich and other WDFW staff for a tour of the Tumwater hatchery and to discuss a monitoring program for WDFW to calculate the effect of the hatchery on nutrients, temperature, dissolved oxygen, and pH. Provided the UW Marine Chemistry Lab contact for low-cost nutrient analyses. Developed a spreadsheet for WDFW to track samples and to calculate the cumulative influent and effluent nutrient load from the facility during both routine operations and maintenance activities.
- Met with LOTT and EPA to discuss options for pollution-reduction projects February 12, 2004. Because the mitigation projects LOTT and the Squaxin Island Tribe are discussing will be implemented prior to the TMDL, a pollution trading framework is premature. However, we discussed options for making progress toward load reductions likely necessary under the TMDL when it is completed.
- Contacted Perry Lund (Ecology) regarding potential milfoil treatments in Capitol Lake in summer 2004. These would significantly affect conditions and the currently scheduled field work. We may need to adapt our monitoring plan should the herbicide application be approved.
- Reviewed proposed WDFW Tumwater hatchery report submitted to Greg Cloud for background information on facilities.
- Met with Sue Davis, Roy Iwai, and Andy Haub March 1 to discuss potential stormwater monitoring sites and purpose.

- Met with LOTT, EPA, and the Squaxin Island Tribe March 15 to discuss potential mitigation projects. Also met March 22 with EPA, Thurston County, Squaxin Island Tribe, NRCS, LOTT, City of Olympia, and City of Lacey to further brainstorm project ideas.
- Contacted Peter Constable (Weyerhaeuser Real Estate Division) regarding appropriate contact for potential property acquisitions if included in mitigation project list developed by LOTT and the Squaxin Island Tribe. He indicated Julie Keough, Vail Tree Farm manager, should be the point of contact.
- Summarized project lab costs and revised 2004 costs to account for deferred projects (e.g., Capitol Lake surveys and stormwater monitoring).
- Sent shape files of gaining and losing reaches (hydrogeology) to John Konovsky (Squaxin Island Tribe).

Project Schedule and Upcoming Tasks

Routine monitoring will continue through the next quarter. In addition, we will began tracking storms through the spring to begin the stormwater monitoring program. Staff gages will be installed at some locations to estimate flows over the storm duration. Should the milfoil herbicide be applied, we will begin the Capitol Lake water quality and macrophyte surveys in the upcoming quarter. If no herbicide application is planned, Capitol Lake surveys will be deferred to summer 2004. Bathymetric surveys may begin in June 2004 pending equipment availability.

Figures and Tables

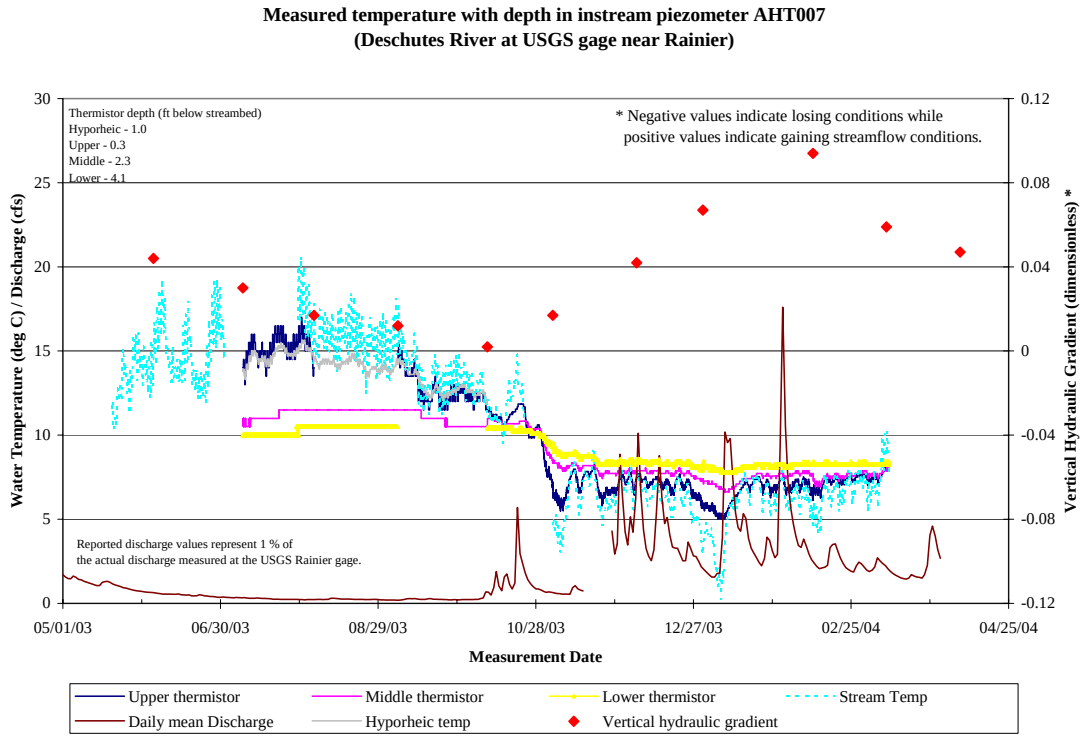

Figure 1. Example water temperature patterns in a gaining reach, for the Deschutes River near the USGS gage at Rainier.

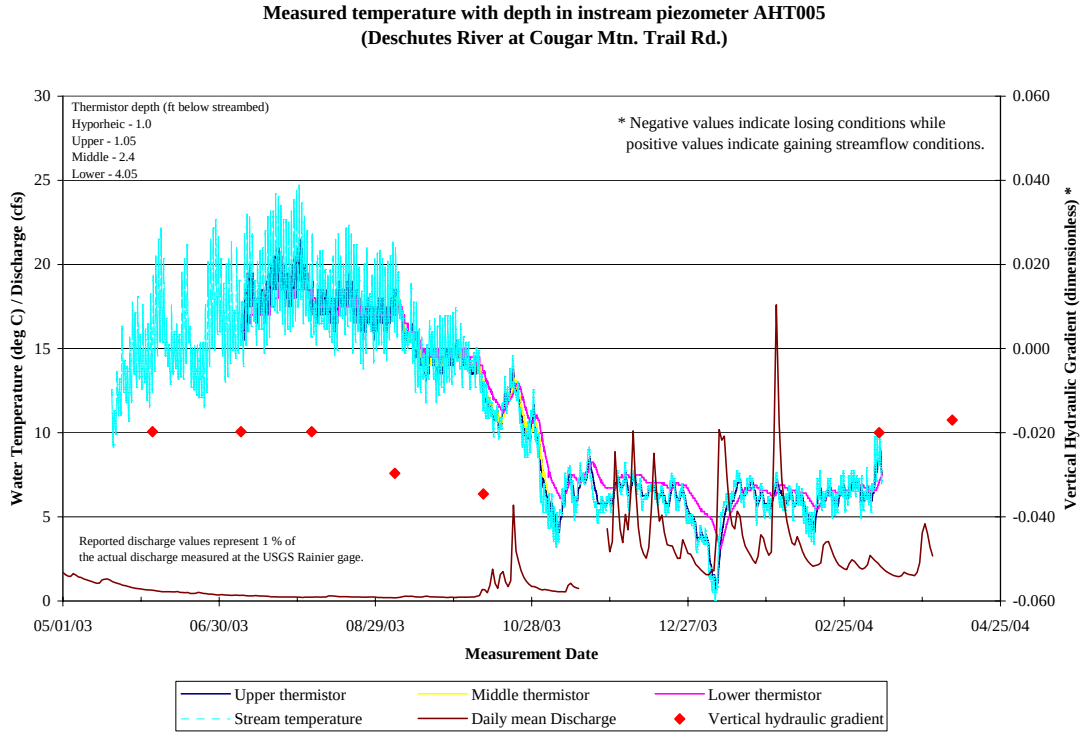

Figure 2. Example water temperature patterns in a losing reach, for the Deschutes River near Cougar Mountain Trail Road.

Table 1. Reconnaissance monitoring fecal coliform levels

Description	Number	Geomean (#/100 mL)	% >200 per 100 mL
Mainstem Deschutes River			
Deschutes River at E St bridge	10	21	0%
Deschutes River at Henderson Blvd SE	10	13	0%
Deschutes River at Reichel Rd	4	89	0%
Deschutes River at Vail Cutoff Rd SE	6	22	0%
Deschutes River nr Cougar Mountain	2	16	0%
Deschutes Tributaries			
Ayer Creek off Sienna Ct	10	35	***20%***
Chambers Creek off 58th Ave SE	10	43	0%
Reichel Creek at Vail Loop Rd	10	62	10%
Spurgeon Creek at Rich Rd	10	48	10%
Capitol Lake and Percival Creek Tributaries			
Black Lake Ditch at Belmore Rd	10	17	10%
Black Lake Ditch near Percival confluence	10	23	10%
Percival Creek near mouth	10	35	10%
Percival Creek nr Black Lake Ditch confluence	10	80	***50%***
Capitol Lake at outlet	3	16	0%
Capitol Lake at Railroad Trestle	10	10	***20%***
Budd Inlet Tributaries			
Adams Creek at Boston Harbor Rd	10	52	10%
Butler Creek at French Loop Rd	10	68	10%
Ellis Creek at East Bay Dr	10	55	***20%***
Indian Creek at Quince Ave	10	***321***	***70%***
Mission Creek at East Bay Drive	10	95	***20%***
Moxlie Creek at East Bay Dr	10	***337***	***70%***
Moxlie Creek at Plum St and Henderson	8	***121***	***25%***
Schneider Creek at West Bay Dr	10	34	0%

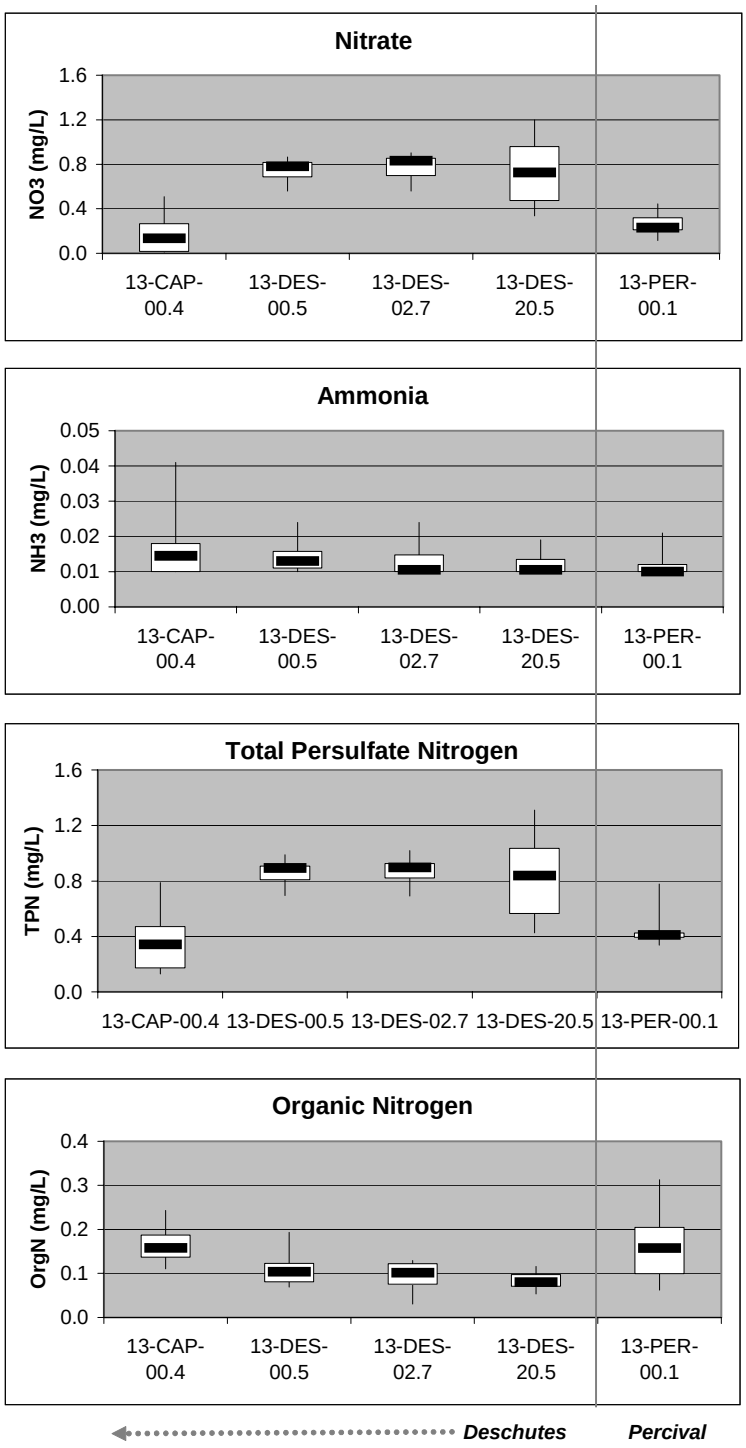

Figure 3. Summary of 2003 nitrogen concentrations along the Deschutes River and in Percival Creek.

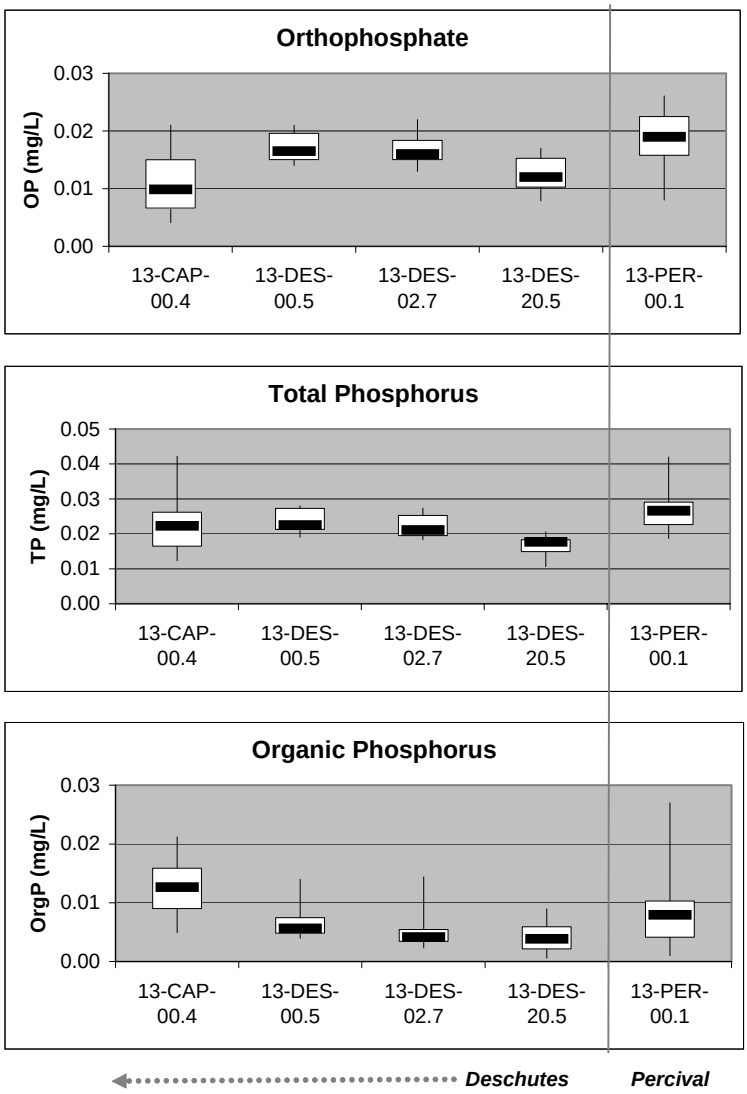

Figure 4. Summary of 2003 phosphorus concentrations along the Deschutes River and in Percival Creek.

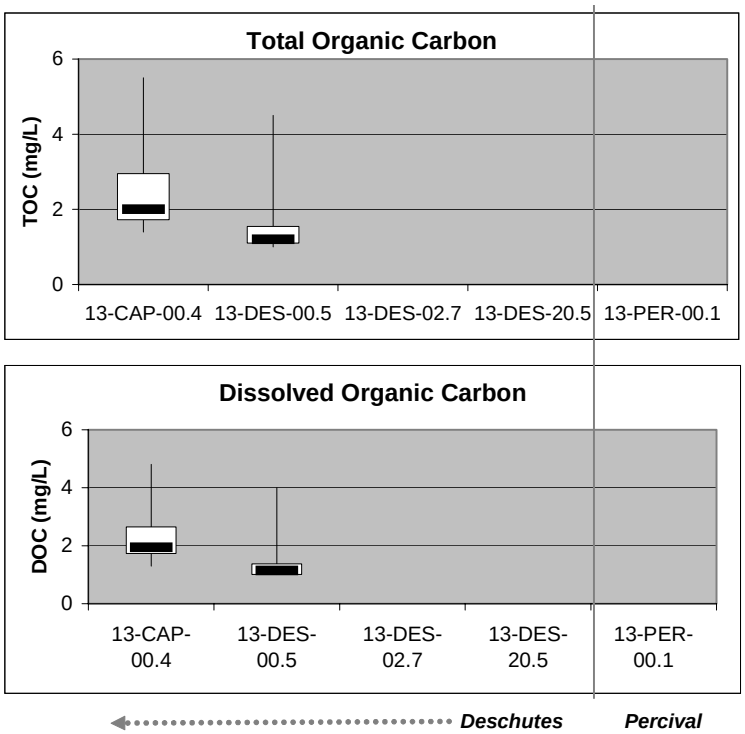

Figure 5. Summary of 2003 carbon concentrations along the Deschutes River and in Percival Creek.

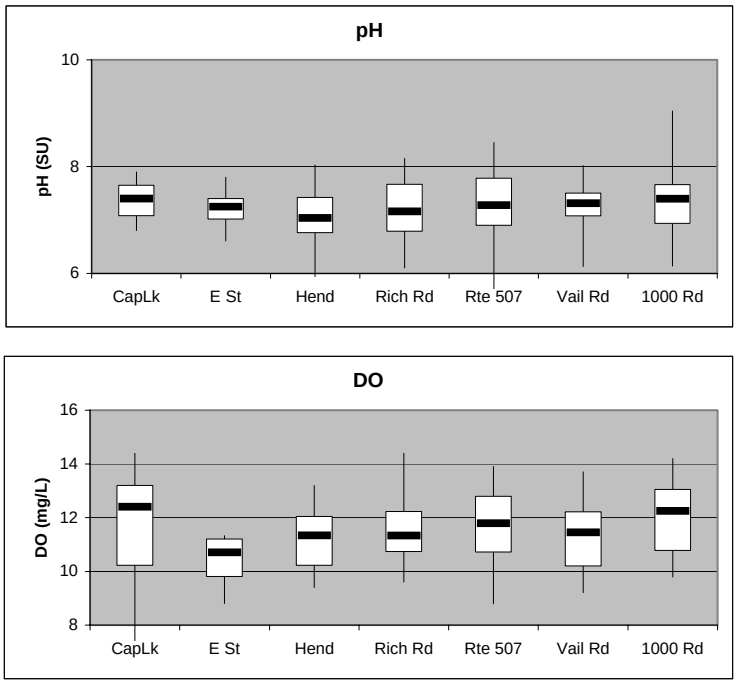

Figure 6. Thurston County historical data summary for Deschutes River pH and dissolved oxygen levels.

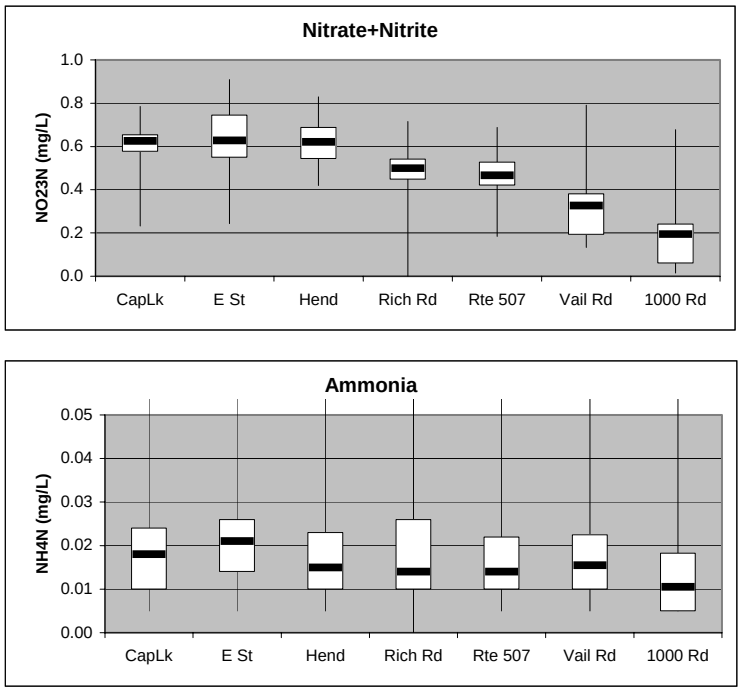

Figure 7. Thurston County historical data summary for Deschutes River nitrogen levels.

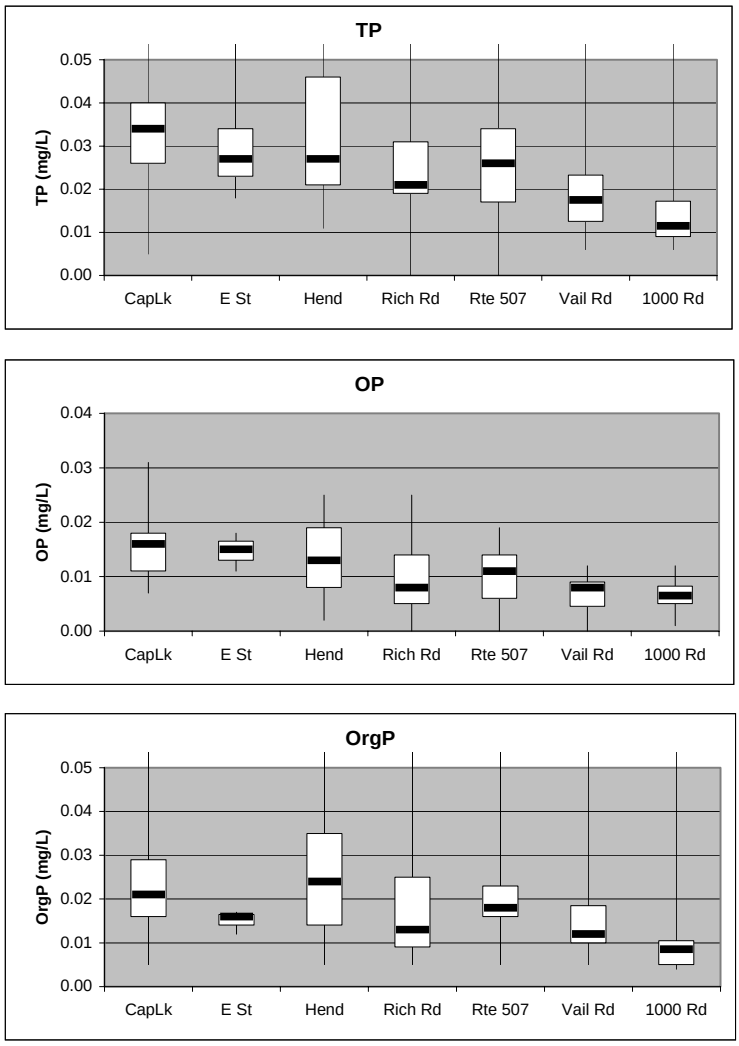

Figure 8. Thurston County historical data summary for Deschutes River phosphorus levels.

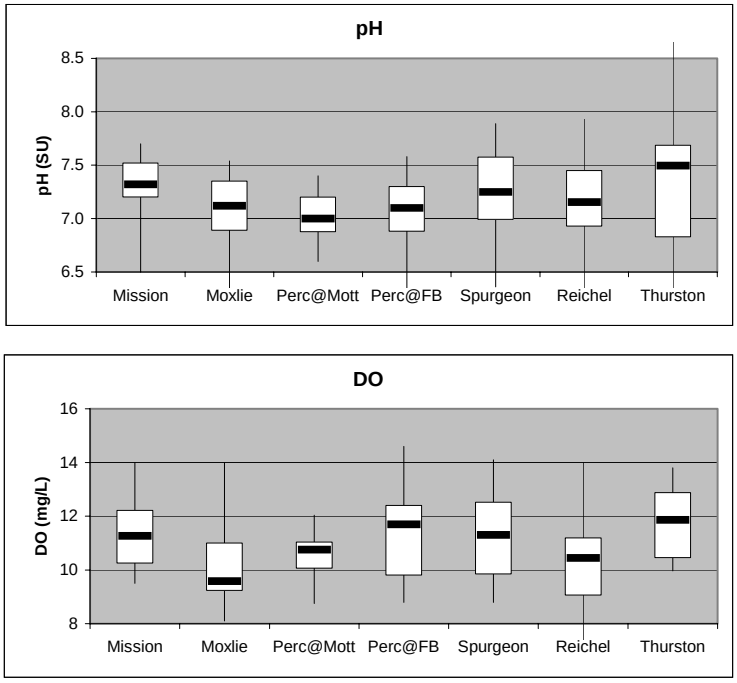

Figure 9. Thurston County historical data summary for Deschutes River, Capitol Lake, and Budd Inlet tributary pH and dissolved oxygen levels.

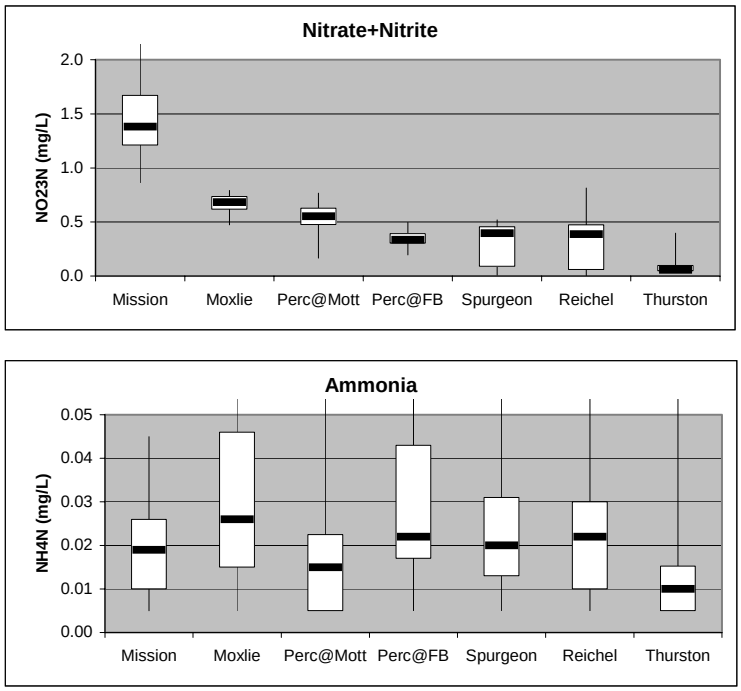

Figure 10. Thurston County historical data summary for Deschutes River, Capitol Lake, and Budd Inlet tributary nitrogen levels.

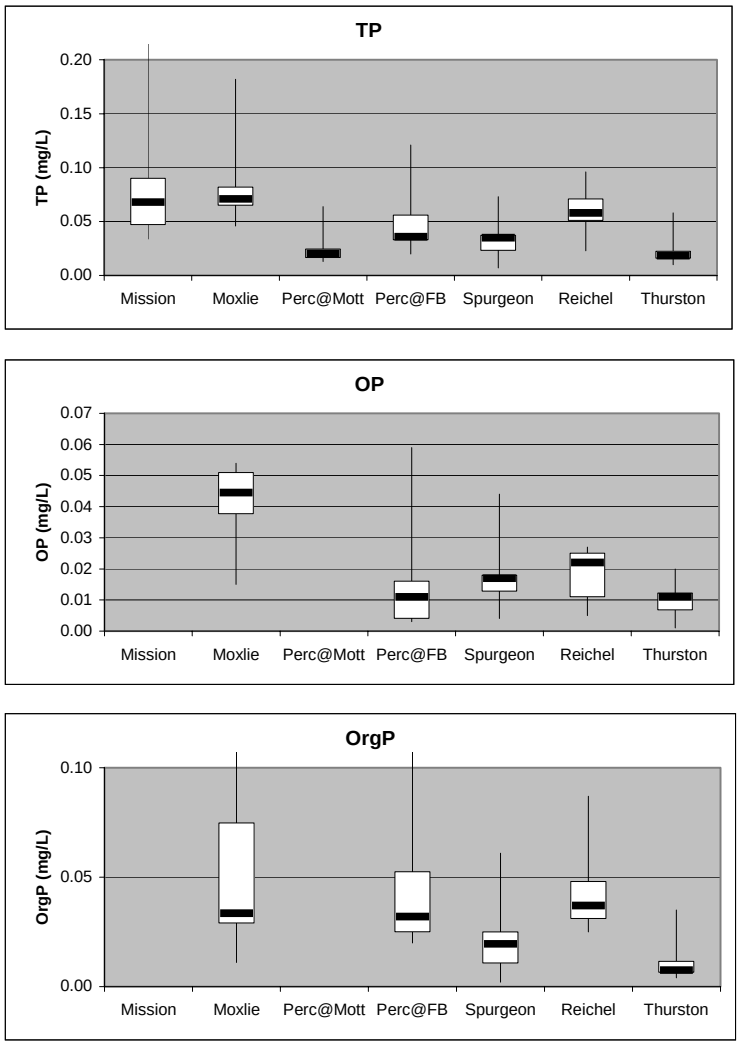

Figure 11. Thurston County historical data summary for Deschutes River, Capitol Lake, and Budd Inlet tributary phosphorus levels.

Table 2. Fecal coliform data collected to date in 2004.

Station	1/14/04	1/15/04	1/28/04	1/29/04	2/11/04	2/12/04	2/25/04	2/26/04	3/10/04	3/11/04	3/24/04	3/25/04
Mainstem Deschutes River												
13-DES-00.5	38		11		2		1		2		1	
13-DES-02.7		20	5		1		1		1		2	
13-DES-05.5		17		28		6		8		7		15
13-DES-09.2		5		12		1		7		6		27
13-DES-20.5		2		15		2		2		4		11
13-DES-28.0				4								
13-DES-28.6		1				2		17		1		2
Deschutes River Tributaries												
13-AYE-00.0		12		13		7		2		2		11
13-CHA-00.1		17	5			13		4	2			9
13-HUC-00.3		1		1		1		1		1		1
13-REI-00.9		2		14		3		8		4		***420***
13-SPU-00.0		7		9		9		8		8		11
Capitol Lake and Percival Creek Tributaries												
13-BLA-00.0	8		8		1		1		1		3	
13-BLA-02.3	7		12		3		26		2		1	
13-PER-00.1	8		36		17		1		4		1	
13-PER-01.0	9		190		7		1		14		8	
13-CAP-00.4	33		20		5		23		1		3	
Budd Inlet Tributaries												
13-ADA-00.5	7		13		20		71		20		25	
13-BUT-00.1	4		23		15		79		25		24	
13-ELL-00.0	15		29		25		10		27		8	
13-IND-00.2	33		22		9		18		150		26	
13-MIS-00.1	8		24		2		2		11		6	
13-MOX-00.0	140		***310***		60		37		***380***		***410***	
13-MOX-00.6	4		17		2		140		36		9	
13-MOX-CUL					11							
13-SCH-00.1	79		16		4		2		4		5	

Table 3. Nutrient, alkalinity, and TSS data collected to date in 2004.

Date	Station	TPN (mg/L)	NO23N (mg/L)	NH3N (mg/L)	TP (mg/L)	OP (mg/L)	TOC (mg/L)	DOC (mg/L)	ALK (mg/L)	TSS (mg/L)
1/13/04	13-BLA-02.3	0.451	0.246	0.020	0.0168	0.012				
1/13/04	13-CAP-00.0	0.669	0.514	0.012	0.0205	0.016	2.5	2.3		3
1/13/04	13-CAP-00.4	0.681	0.503	0.016	0.0229	0.018	3.0	2.6		3
1/13/04	13-DES-00.5	0.679	0.562	0.010	0.0175	0.015	2.0	1.8	28	6
1/13/04	13-PER-00.1	0.535	0.307	0.013	0.0173	0.011	4.5	4.2		4
1/13/04	13-PER-01.0	0.696	0.525	0.010	0.0121	0.009				
1/14/04	13-AYE-00.0	0.987	0.647	0.023	0.0647	0.049	7.6	7.2		
1/14/04	13-CHA-00.1	1.500	1.300	0.010	0.0180	0.014	5.5	5.0		
1/14/04	13-DES-02.7	0.658	0.578	0.010	0.0178	0.016	2.0	1.7	28	4
1/14/04	13-DES-05.5	0.638	0.542	0.010	0.0162	0.015	2.1	1.7	27	6
1/14/04	13-DES-09.2	0.623	0.539	0.010	0.0145	0.014	1.7	1.5	26	5
1/14/04	13-DES-20.5	0.453	0.413	0.010	0.0135	0.013	1.7	1.6	25	5
1/14/04	13-DES-28.6	0.338	0.291	0.010	0.0193	0.011	1.4	1.3	23	3
1/14/04	13-DES-37.4	0.210	0.168	0.010	0.0085	0.010	1.3	1.1	20	1

1/14/04	13-REI-00.9	0.731	0.454	0.010	0.0235	0.012	6.5	6.2		
1/14/04	13-SPU-00.0	0.608	0.429	0.012	0.0233	0.018	3.9	3.7		
1/27/04	13-BLA-02.3	0.497	0.293	0.017	0.0162	0.012				
1/27/04	13-CAP-00.0	0.705	0.589	0.010	0.0238	0.018	2.8	2.6		2
1/27/04	13-CAP-00.4	0.706	0.586	0.014	0.0275	0.018	2.5	2.5		2
1/27/04	13-CHA-00.1	1.740	1.490	0.010	0.0209	0.015	4.6	4.3		
1/27/04	13-DES-00.5	0.743	0.663	0.010	0.0195	0.016	2.1	1.9	32	4
1/27/04	13-DES-02.7	0.723	0.662	0.010	0.0195	0.016	2.2	1.9	31	3
1/27/04	13-PER-00.1	0.519	0.328	0.011	0.0196	0.012	4.8	4.5		3
1/27/04	13-PER-01.0	0.717	0.542	0.010	0.0165	0.011				
1/28/04	13-AYE-00.0	1.040	0.760	0.020	0.0587	0.037	5.6	5.4		
1/28/04	13-DES-05.5	0.697	0.618	0.010	0.0193	0.014	2.3	1.9	30	3
1/28/04	13-DES-09.2	0.700	0.623	0.010	0.0175	0.013	2.0	1.7	29	4
1/28/04	13-DES-20.5	0.603	0.513	0.010	0.0162	0.013	1.9	2.0	28	2
1/28/04	13-DES-28.0	0.443	0.375	0.010	0.0133	0.010	1.6	1.5	27	1
1/28/04	13-DES-37.4	0.295	0.224	0.010	0.0114	0.010	1.5	1.3	24	1
1/28/04	13-REI-00.9	0.819	0.520	0.010	0.0381	0.015	7.1	6.6		
1/28/04	13-SPU-00.0	0.634	0.415	0.013	0.0286	0.020	3.5	3.2		
2/10/04	13-BLA-02.3	0.485	0.333	0.010	0.0129	0.007				
2/10/04	13-CAP-00.0	0.707	0.621	0.010	0.0196	0.012	2.3	2.4		2
2/10/04	13-CAP-00.4	0.653	0.589	0.010	0.0163	0.015	2.6	2.4		2
2/10/04	13-DES-00.5	0.801	0.745	0.010	0.0191	0.013	1.6	1.5	33	4
2/10/04	13-DES-02.7	0.790	0.741	0.010	0.0191	0.013	1.7	1.4	32	3
2/10/04	13-PER-00.1	0.499	0.355	0.010	0.0229	0.009	4.4	4.3		4
2/10/04	13-PER-01.0	0.721	0.610	0.010	0.0142	0.007				
2/11/04	13-AYE-00.0	1.500	1.290	0.015	0.0428	0.050	3.9	3.6		
2/11/04	13-CHA-00.1	1.550	1.380	0.010	0.0164	0.023	4.5	4.1		
2/11/04	13-DES-05.5	0.765	0.734	0.010	0.0175	0.025	1.8	1.5	31	5
2/11/04	13-DES-09.2	0.762	0.729	0.010	0.0167	0.024	1.6	1.5	31	4
2/11/04	13-DES-20.5	0.622	0.582	0.010	0.0163	0.023	1.5	1.5	30	2
2/11/04	13-DES-28.6	0.429	0.413	0.010	0.0123	0.019	1.6	1.1	27	1
2/11/04	13-DES-37.4	0.250	0.233	0.010	0.0094	0.018	1.1	1.0	25	1
2/11/04	13-REI-00.9	0.926	0.574	0.012	0.0303	0.024	6.1	5.8		
2/11/04	13-SPU-00.0	0.605	0.476	0.012	0.0198	0.030	3.0	2.9		
3/23/04	13-BLA-02.3	0.431	0.274	0.010	0.0098	0.003				
3/23/04	13-CAP-00.0	0.638	0.485	0.010	0.0187	0.008	2.8	2.1		1
3/23/04	13-CAP-00.4	0.565	0.367	0.010	0.0181	0.006	3.7	2.2		1
3/23/04	13-DES-00.5	0.798	0.693	0.010	0.0168	0.009	1.7	1.4	40	2
3/23/04	13-DES-02.7	0.878	0.712	0.010	0.0170	0.010	1.7	1.4	40	2
3/23/04	13-PER-00.1	0.493	0.282	0.010	0.0156	0.006	5.2	4.0		3
3/23/04	13-PER-01.0	0.606	0.466	0.010	0.0185	0.007				
3/24/04	13-AYE-00.0	0.724	0.500	0.015	0.0504	0.023	4.6	4.0		
3/24/04	13-CHA-00.1	1.480	1.300	0.010	0.0204	0.009	4.7	4.6		
3/24/04	13-DES-05.5	0.749	0.650	0.010	0.0162	0.008	1.7	1.6	38	2
3/24/04	13-DES-09.2	0.748	0.669	0.010	0.0144	0.007	1.4	1.4	37	2
3/24/04	13-DES-20.5	0.575	0.485	0.010	0.0158	0.009	1.7	1.6	36	2
3/24/04	13-DES-28.6	0.343	0.270	0.010	0.0133	0.006	1.5	1.4	33	2
3/24/04	13-DES-37.4	0.180	0.124	0.010	0.0107	0.007	1.4	1.9	30	3
3/24/04	13-REI-00.9	0.669	0.267	0.034	0.0757	0.023	9.0	10.0		
3/24/04	13-SPU-00.0	0.372	0.218	0.010	0.0355	0.015	2.9	2.9		

Table 4. Dissolved oxygen (Winkler titration) data collected to date in 2004.

Station	1/13/04	1/14/04	1/27/04	1/28/04	2/10/04	2/11/04	2/24/04	2/25/04	3/9/04	3/10/04	3/22/04	3/24/04
Mainstem Deschutes River												
Deschutes at 1000 Rd		11.65		12.05		12.52		11.75				11.41
Deschutes at Vail Cutoff Rd		11.42		11.55		12.20		11.65		11.90		11.28
Deschutes at Rte 507		11.45		11.52		12.32		11.70		11.78		11.40
Deschutes nr Rich Rd		11.28		11.20		11.82		11.10		11.30		11.24
Deschutes off Riverlea		11.27		11.24		11.90		11.15		11.30		10.78
Deschutes at Henderson		11.00	11.40		11.70		11.10		11.07		10.90	
Deschutes at E St	11.35		11.45		11.75		11.05		11.08		11.37	
Deschutes River tributaries												
Huckleberry		11.00		11.35		12.00		11.22		11.40		10.90
Reichel		10.75		10.30		11.65		9.48		9.20		9.19
Spurgeon		10.70		10.45		11.62		10.75		10.90		10.43
Ayer		4.72		6.80		7.60		6.71		6.40		7.51
Chambers		10.10	10.60			10.90		10.20	10.18			10.50
Capitol Lake and tributaries												
Black Lk Ditch at Belmore	11.31		11.41		11.28		11.60		10.87		10.71	
Black Lk Ditch nr Percival	11.70		11.45		11.55		11.00		10.70		10.48	
Percival nr Black Lk Ditch confluence	11.90		11.70		12.05		11.03		10.65		10.60	
Percival nr mouth	12.35		12.05		12.10		11.30		11.08		10.81	
Capitol Lk at 5th Ave	12.51		12.22		12.49		11.65				11.71	
Capitol Lk at RR trestle	12.29		12.00		12.34		11.50		13.32		11.61	

Table 5. pH data collected to date in 2004.

Station	1/13/ 04	1/14/ 04	1/27/ 04	1/28/ 04	2/10/ 04	2/11/ 04	2/24/ 04	2/25/ 04	3/9/ 04	3/10/ 04	3/22/ 04	3/24/ 04
Mainstem Deschutes River												
Deschutes at 1000 Rd		7.50		7.46		7.36		7.43				7.64
Deschutes at Vail Cutoff Rd		7.30		7.17		7.05		7.17		7.31		7.34
Deschutes at Rte 507		7.30		7.29		7.24		7.30		7.46		7.48
Deschutes nr Rich Rd		7.05		7.15		7.02		7.14		7.41		7.55
Deschutes off Riverlea		7.20		7.03		7.00		7.06		7.25		7.25
Deschutes at Henderson		7.39	7.37		7.26		7.26		7.31		7.20	
Deschutes at E St	7.22		7.29		7.12		7.24		7.37		7.34	
Deschutes River tributaries												
Huckleberry		7.38		NR		7.40		7.37		7.50		7.45
Reichel		7.05		6.83		6.88		6.79		6.90		7.05
Spurgeon		7.13		7.07		7.03		7.16		7.47		7.29
Ayer		6.70		6.85		6.68		6.70		6.89		6.86
Chambers		7.08	7.10			6.91		7.02	7.06			7.16
Capitol Lake and tributaries												
Black Lk Ditch at Belmore	7.24		7.37		7.29		7.26		7.34		7.22	
Black Lk Ditch nr Percival	7.13		7.28		7.07		7.10		7.12		7.02	
Percival nr Black Lk Ditch confluence	7.03		7.25		7.04		7.13		7.18		7.18	
Percival nr mouth	7.23		7.44		7.25		7.36		7.44		7.42	
Capitol Lk at RR trestle	7.09		7.50		7.35		7.45		7.90		7.70	
Capitol Lk at 5th Ave	7.20		7.48		7.33		7.45				7.83	
Budd Inlet tributaries												
Adams												
Butler	7.18		7.46		7.32		7.43		7.45		7.44	
Ellis	7.44		7.49		7.21		7.35		7.26		7.41	
Indian	NR		7.25		7.13		7.03		7.27		7.24	
Mission	7.33		7.49		7.41		7.42		7.45		7.78	
Moxlie at Plum and Henderson	7.10		7.36		7.31		7.33		7.34		7.29	
Schneider	7.35		7.60		7.45		7.58		7.68		7.57	